Question Paper

Exam Date & Time: 01-Dec-2023 (10:00 AM - 01:00 PM)



MANIPAL ACADEMY OF HIGHER EDUCATION

Manipal School of Information Sciences (MSIS), Manipal First Semester Master of Engineering - ME (Microelectronics and VLSI Technology) Degree Examination - November / December 2023

VLSI Fabrication Technology [MVT 5101]

Marks: 100

Duration: 180 mins.

Friday, December 1, 2023

Answer all the questions.

- ¹⁾ Illustrate the process flow along with mask details to realize a ⁽¹⁰⁾ CMOS inverter circuit on an intrinsic Si- substrate.
- (a) Write one application each of Silicon in its crystalline and ⁽¹⁰⁾ polycrystalline form in integrated circuit (IC) technology.
 (b) Write the rationale behind the trend in miniaturization of devices in IC industry? Comment on the limits of miniaturization.
- ³⁾ (a) As a VLSI engineer, if you have to choose between a ⁽¹⁰⁾ "class-10" and "class-1000" clean room to perform photolithography process, which clean room you will choose to perform the process. Support your answer with proper reasons.

(b) Choose among Si and Ge to realize a typical MOSFET device. Provide the rationale behind the choice of material selection.

- ⁴⁾ With neat figures, graphs and mathematical models, illustrate ⁽¹⁰⁾ the process of CZ crystal growth.
- ⁵⁾ (a) Examine the relationship between the minimum feature ⁽¹⁰⁾ size realizable thorough lithography and the wavelength of light source used for lithography process.

(b) With an example of a device, compare positive and negative photo-resist with respect to the photo mask pattern.

⁶⁾ (a) Compare SiO2 and photoresist (PR) as mask material ⁽¹⁰⁾

during ion-implantation doping process?(b) Distinguish between dry and wet oxidation process for SiO2 growth.

- ⁷⁾ For SiO2 oxidation process, differentiate between the reaction ⁽¹⁰⁾ limited process and diffusion limited process in growth of oxide.
- ⁸⁾ Select between diffusion process and ion implantation process ⁽¹⁰⁾ to realize shallow junctions in semiconductor device fabrication. Justify your answer in terms of doping profile, and process parameters.
- ⁹⁾ (a) Evaluate ion-stopping mechanisms encountered during ion- ⁽¹⁰⁾ implantation process and its impact on doping profiles of light and heavy dopant ions.

(b) Evaluate the role of electric field and magnetic field controls in designing various module units of a typical ion-implanter system.

¹⁰⁾ Select between CVD process and PVD process for depositing ⁽¹⁰⁾ a thin film of metal layer on Si substrate. Further, illustrate the process of thin film deposition along with a real time application.

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